BREEDING HABITS AND EARLY STAGES OF THE GOURAMI (*OSPHRONEMUS GORAMY* LACEPEDE).[1]

BY

C. V. KULKARNI, B.A. (HONS.), M.SC., PH.D.

Piscicultural Assistant, Department of Industries, Bombay.

(*Communicated by* DR. S. B. SETNA, M.SC., F.R.M.S., PH.D. (*Cantab*).

(*With seven Text-figures*).

CONTENTS.

INTRODUCTION.

The cultivation of gourami as a substitute for marine fish where this is not readily available, is being increasingly undertaken in tropical countries, including India. Literature on the bionomics of the fish is thus always growing. Papers describing aspects such as the nesting, breeding and feeding habits of the fish have, from time to time, been published by various authors, including Carbonnier (as quoted by Jones), Gilbert (1894), Jordan (1905), Sundara Raj (1916), Villadolid (1936), Roxas and Umali (1937), and Jones (1939). The last-mentioned paper shows that as late as 1939 there was considerable misunderstanding regarding the nest building habits of gourami. Further, the papers compiled by the Philippine authors

[1] The Genus '*Osphromenus*' (Commerson) Lacépède mentioned by Day (p. 369) is probably a misnomer. According to Max Weber (p. 344) Lacépède described genus *Osphronemus* and not *Osphromenus*. *Osphronemus goramy* Lacépède and *Osphromenus olfax* (Cuv. & Val.) are, however, synonyms and Lacépède's name is retained because of its priority.

Villadolid (1936) and Roxas and Umali (1937) which give exhaustive information on the breeding of gourami, are not quite complete, as they omit certain details about the nesting habits and descriptions of early larval stages. The form described as a newly hatched larva by Roxas and Umali (op. cit.) is, according to the present author, a fry 10 days old. Moreover, there are three earlier stages of the larva which have, apparently, not been recorded so far. It is hoped that observations recorded in this paper will remove certain misapprehensions about the earliest stages of the fish and be of some help in furthering our knowledge of gourami, which has of late been increasingly popular.

Acknowledgement.

The author takes this opportunity of expressing his best thanks to Dr. S. B. Setna, Fisheries Officer, for his valuable guidance and constant encouragement at every stage of the investigation.

Breeding habits of *Osphronemus goramy* Lacépède.

Breeding Season.—A fairly representative account of the breeding habits of gourami is given by Villadolid, who, in a memoir published in 1936, observes as follows:—

'From time immemorial the gourami has been pond-raised in Java. According to Mr. Delsman, of Batavia (Delsman, 1926) the gourami in Java make their nests nearly the whole year round, but most frequently in July and August. He further states that the wet season is the least favourable. According to Theodore Gill (1874), however, the spawning season of gourami in Mauritius and Bourbon falls in the autumn (March and April) and spring (September and October). In the Philippines spawning gourami were first noticed in the Bureau of Science ponds in April 1930. Gourami reared in the Escudero farm were reported to have spawned for the first time in September 1934. The indications are that gourami may spawn at any time during the year.'

Sundara Raj (1916) states that the breeding season in Java is March and in Madras about May, but in the official bulletin of the Department of Fisheries, Madras, dated December 8, 1939, he describes gourami as breeding twice a year, in February and March and again in September to November. Roxas and Umali (op. cit.) affirm that the fish breeds throughout the year and Aquino (1935) also concurs with them. In Bombay, however, my observations during the past four years have shown that the fish breeds throughout the year except during the monsoon from June to September. The interruption in breeding may be due to the rapidly changing levels of ponds at this time, which makes it difficult to build a nest at a particular depth from the surface. The peak period of breeding being April and May. These observations appear, in some degree to be corroborated by those of Roxas and Umali (1937), who state that 'The peak of the breeding season occurs during the warm months from March to May'. There is one instance however, when fry of Gourami were found in one of the ponds in Bombay as early as November. The fry, which measured about $1\frac{1}{2}$ in. to $1\frac{3}{4}$ in. in length, were first noticed in November, 1941.

To attain this size the fry must have hatched at least 2 months previously, i.e. in August or September. A factor which may perhaps explain this apparently unseasonal hatching of the fish is that scarcely any rain fell after the middle of August. The level of the pond must have been almost static and this comparatively still condition of the water must have induced the fish to build its nest and to breed earlier than usual.

The varying records of breeding habits, although from different quarters of the Asiatic continent, are from nearly the same tropical climatic zone, and provide no obvious reason for the disparity in the characteristics of the gourami. Even in India there is no agreement between the records from Bombay and Madras. The fish is known not to breed in Madras during the cold weather.

As a matter of fact, the cold weather at Madras is not so sharp as to inhibit this activity. If low temperatures were at all to bring about such an effect, it should have been more pronounced in the Philippines, where, on the contrary, the fish has been observed to breed throughout the year. The climate of Bombay does not vary greatly from that of Madras, and accordingly the habits of the gourami should manifest greater similarity than divergance at these two places.

Material for the nest.—Gourami is fairly well known for its habit of building a nest in the water for the reception of its eggs. Sundara Raj (op. cit.) who described the habits of gourami, quoted Jordan's view (1905 p. 369) that 'the nest was of a spherical form, composed of plants, preferably tufts of a peculiar grass (*Panicum jumentorum*) which grows on the surface of the water'. He gives, however, in the administrative report of the Madras Fisheries Department for 1932-33 a list of quite different hydrophytes which are used to build nests. Roxas and Umali (op. cit.) give yet another list of plants and articles used for this purpose and state that 'it (nest) is composed of plants, mud and other available floating and submerged material'. The authors have rightly noted that the fish uses for its purpose whatever is available in the pond. It is unnecessary to introduce in a pond the typical grass and materials which the gourami might previously have used for nidification. Once the fish has chosen a particular material, it always manifests an instinctive preference for it as long as it is available. This was well illustrated in a tank at Bandra, Bombay Suburban District, where the gourami always employed hitherto unlisted material to build nests in preference to other commonly used plants. Observations of the fish bred in the tank during the last four years show that gourami manifests a special preference for long peals and fibres of lotus stocks (*Nelumbium* sp.) left over in the pond after the decomposition of the pulp, although the tank may be and is actually littered with such common hydrophytes as *Ceratophyllum, Hydrilla,* etc., which are generally recorded as plants used in nests built by this fish. Probably, the softness of the lotus fibres, their binding qualities and the ease with which they may be carried through the water makes the first choice with gourami for nest building. *Ceratophyllum* and *Hydrilla* were used by the fish to only a limited extent. *Ipomea, Pistia, Potamogeton,*

Eichhornia, and *Limnanthemum*, though available in the pond, were rarely utilised. These plants, along with some fibrous roots and tufts of grasses, were used by the fish for nidification in other ponds. This fact proves that gourami has definite likes and dislikes in regard to the choice of material for the building of its nests. The fish does not, however, limit itself to any particular material, so that when occasion arises it can build its nest from whatever material is available.

Site for the nest.—As the breeding season approaches, the parents search for a site for a nest. The place selected is generally at the edge of a pond, but an additional factor in the choice of a site is that the selected place should have ample free space below the nest so that the fish can go right below to lay eggs and also to produce currents in the water by moving it with the fins. For this reason steeper sides of ponds lined either by irregular stones and crevices or by firm grass affording support to the nests are generally favoured. Sides of ponds with gradually sloping banks are not quite suitable. Such sites, although unfrequented by people and affording the necessary stillness, were found to have been disregarded by the fish in preference for steeper sides, although these adjoined busy thoroughfares. In the Administration report of the Madras Fisheries Department for 1933-34, Sundara Raj while describing the habits of gourami in the construction of nests observes 'to begin with they scoop a hole in the muddy margins of the pond among the grass or bulrush'. This habit of making a hole may as well be for the same purpose of securing space below the nest as pointed out above. Nests have also been observed in the centre of the ponds wherever rocks or any other structures held out suitable support near the surface of the water. Nests have also been found hung on the entangled shoots of *Ceratophyllum* right in the middle of tanks, and their secure position in such surroundings was due to their being intertwined with lotus stalks. In Java tufts of fibres of palm, *Arenga saccharifera* are suspended in ponds to induce the fish to build nests in the tufts. In Madras the same practice has been reported to be successful at some places (1933-34). Roxas and Umali (op. cit. page 442) record nests built in the floating roots of *Eichhornia* in a cement concrete tank in Manila. It should be remembered, however, that such precarious places as the floating roots would be used by the fish only as a last resort when nothing better was available. The ready manner in which the fish adapted itself to the unfamiliar conditions and exploited them to the utmost advantage was indeed noteworthy.

Nest:—To start with, the parents carry the building material in their mouths and fix it on the selected spot with the help of their thick snouts. If a crevice between stones is to serve as a starting point the material is firmly rammed into it, and additional material is entangled to form a nest. As with the nests of birds, the softer material on which the eggs are deposited is placed in the centre. The nest is generally about half a foot below the surface of water or at times even touches it. The opening is usually on the lower side or slants slightly towards the centre of the pond. According to the Philippine authors the fish takes about a week to

build the nest. Sundara Raj's observations show, on the other hand, that it takes about a month to complete.

The size and shape of the nests do not appear to be uniform in all cases and depend mostly on the size of the fish and material of which it is made. It can, however, be said to resemble a bird's nest. Occasionally when the building material is merely wedged in between stones on the border to obtain a support, the nest becomes more elongated or drawn out and has no particular shape. If the material is not very pliable and if the support is firm and easy, the nest becomes compact and shapely. The one observed at Sunkesula farm (Madras) in March, 1937, was made of roots of bulrush and dried blades of grass and appeared quite elegant—almost like a bird's nest. 'The nests' described by Sundara Raj (1932-33) 'measure 6 inches in diameter 7 inches in height'. Roxas and Umali (op. cit.) record bigger nests of about 30 cms. (12 inches) in length and 18 cms. (7.2 inches) in width, but our observations showed that most of the Bombay nests were bigger than the Philippine nests and measured on an average about 15 in. in length and 12 in. in diameter and were placed lengthwise in the ponds.

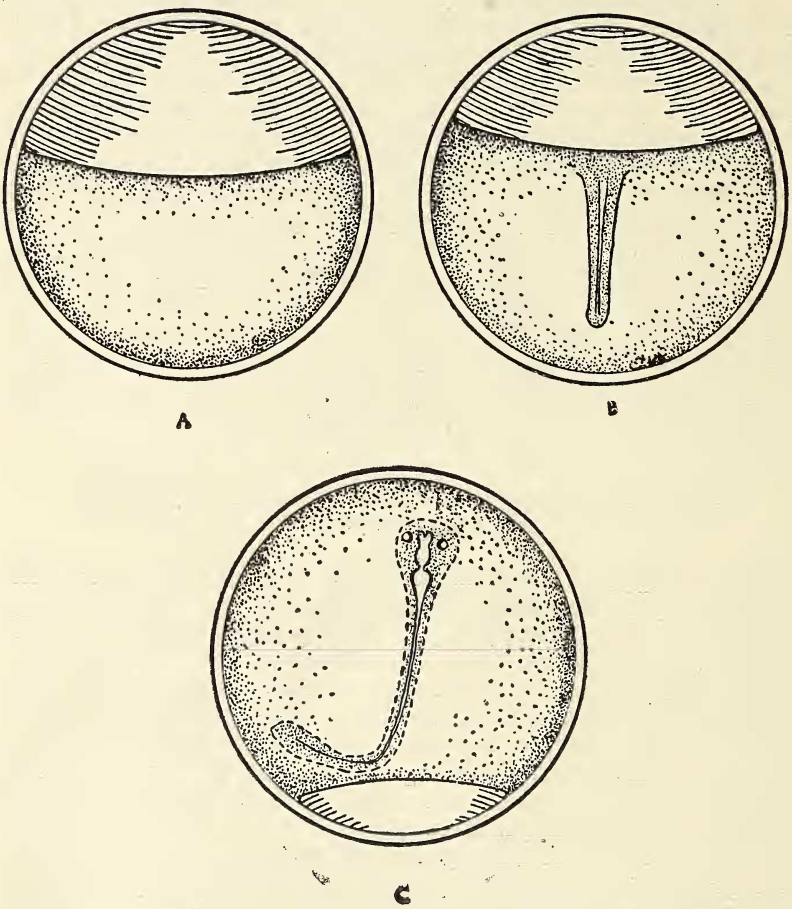
Embryology and larval development of *Osphronemus goramy*.

Eggs.—Eggs are laid in batches. The female goes below the nest, inspects it, then lies on her broad side, lays a cluster of eggs and retires. The male waiting close by then discharges his semen on the eggs to fertilize them and withdraws. This process is repeated several times till all the eggs are laid. A few fibres are then pulled out from the sides of the nest, and the eggs covered with them, so that they are well protected and no intruder can have access to them. Both parents guard the nest in turn, inspect the eggs occasionally and stir the water with their fins to produce a current to help oxygenation.

Records from the Philippines, as well as from Madras show that gourami is known to lay about 800 to 1,000 eggs at a time, but my observations show that the number of eggs laid at a time may be much bigger. On February 21, 1940, a nest in the Bandra tank was found to contain about 3,000 larvae, which had just hatched out, all being nearly of the same age. This observation led the investigator to assume that the eggs might have been laid not only by one but two or more females. This assumption proved, however, to be incorrect as in the subsequent year two other nests in the same tank on April 17, 1941, had each about 2,200 and 2,000 larvae. This fact makes it clear that gourami at least in the pond at Bandra lay eggs prolifically.

The eggs are of a fine lemon yellow colour, glistening remarkably on top owing to a quantity of oil at the upper pole, which occupies more than 1/3 the size of the egg and is comparatively very large. The diameter of the egg is about 2.2 to 2.4 mm. Due to the large quantity of oil in the globule the eggs are buoyant if left free but being always in the nest they are never seen floating

in the water. They are very soft, delicate and unadhesive. The egg membrane, being very tender, collapses even if slightly touched (fig. 1. *a*).



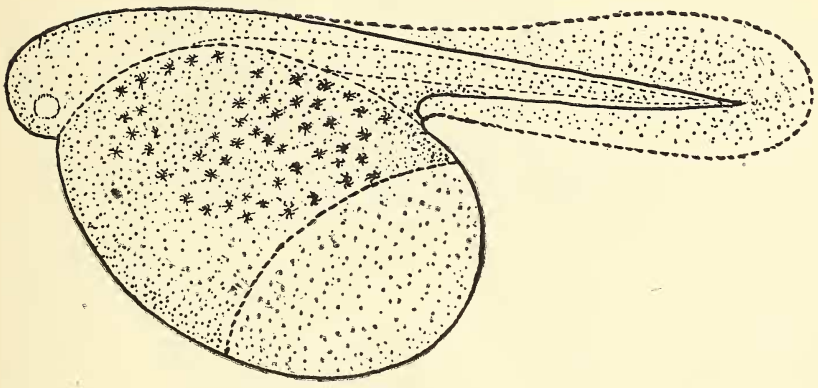
Text-fig. 1.—Egg and early embryonic development of *Osphronemus goramy* (Lacépède) × 18.

(*a*) Egg. (*b*) Egg with embryonic ridge. (*c*) Egg with developing embryo.

'The eggs hatch in about 10 days', according to Roxas and Umali, and in about 15 days according to Villadolid. The time varies, however, according to the season, being shorter in summer and longer in winter. Figures 1b and 1c in the text represent some of the embryonic stages. Fig. 1 *b* shows only the embryonic ridge being formed, while fig. 1 *c* represents an embryo with the cephalic region in the process of formation and the optic region marked out. The caudal portion is also complete.

Newly hatched larva.—Roxas and Umali (op. cit.) record newly hatched fry as being 9 mm. in length and describe it as follows. 'A newly hatched fry is about 9 mm. long, the body being

somewhat elongated. The head measures 5 times in the total length, while the eye is contained 3 times in the length of the head. Although somewhat short, the caudal fin in fully formed. Only the beginning of the soft dorsal and anal fins are evident as fleshy projections, there being as yet no distinct ray formation. The pectoral and the ventral fins are entirely absent, although fleshy indications of the former are already visible. The pigmentation is still wanting except as scattered patches in some parts of the head and body'. My observations show that the first hatchling of Gourami (fig. 2) is much smaller and quite different from what has been described above.

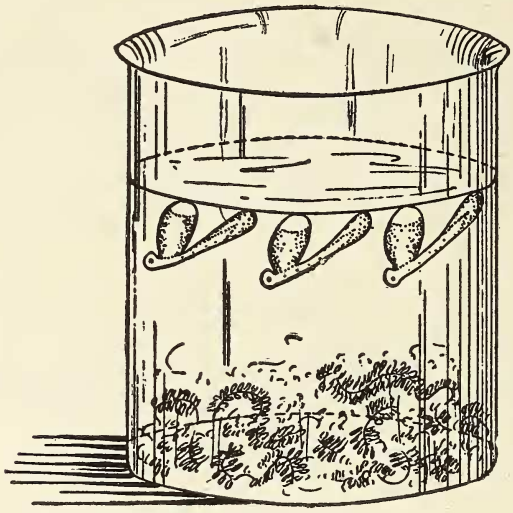


Text-fig. 2.—Newly hatched larva of *Osphronemus goramy* (Lacépède) ×Ca. 20.

Its (newly hatched larva) total length is about 5.3 mm. It has a comparatively large yolk-sac of about 3 mm. in length and 2.0 mm. in breadth and the latter is closely attached below the head by the longer axis. The length of the head is contained about nine times, and the height about 8.5 times, in the total length of the larva. The anterior end (snout) is almost rounded. The mouth is not perceptible. The sclerotic coats and the lenses of the eyes are developed, but there is no pigmentation as yet. The pectoral and ventral fins are not developed at all. The dorsal, caudal and the anal fins also are not present, but, in their stead, a thin vertical fold starts dorsally from about 1/3 the total length of the larva from the head and is continued ventrally round the caudal end to meet the yolk-sac at about half the total length. Two or three small chromatophores are seen on the dorsal side of the larva posterior to the head, and numerous ones of the same size are distributed on the yolk-sac dorsally and posteriorly. These chromatophores are not visible to the naked eye and can be seen only through a magnifying lens. The oil globule is yet persistent and is quite visible, occupying the rear end of the yolk-sac.

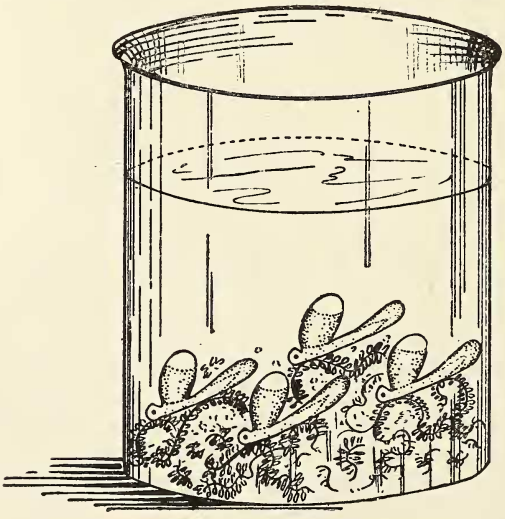
A remarkable feature about the newly hatched larva is the manner of its suspension immediately below the surface of the water. The larva at this stage assumes a supine position with its tail directed

upwards and forms an angle of about 30 degrees with the plane of the water (fig. 3).



Text-fig. 3.—Early hatchlings floating in inverted position (diagrammatic).

The concentration of oil at the end of the postero-ventral side of the yolk-sac perhaps acts as a buoyant agent which causes the larva to float towards the surface film of the water. The larva at this stage is almost quiescent and, unless disturbed, prefers to remain motionless near the surface. On disturbance it swims away swiftly in the same inverted condition and again resumes its original position elsewhere. In the natural environment this quiescent stage is always passed in the nest and the larva does not come to the surface of the water in spite of its buoyancy.

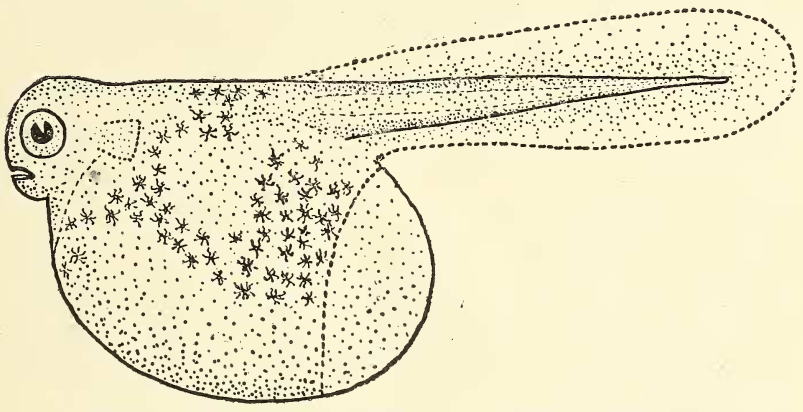


Text-fig. 4.—Early hatchlings attached to weeds under water (diagrammatic).

Two-day old larva:—Late on the second day pigment begins to appear in the eyes. Fleshy indications of the pectoral fins and a minute slit in place of the mouth are also visible. An interesting fact noted at this stage was that, despite the buoyancy due to the oil globule, the larva descended to the bottom of the observation tank and rested on the weeds, the general appearance of its position being the same as when it was floating immediately under the surface film of water (fig. 4).

Cement glands such as those recorded by Jones (1940) on the head and nape of *Macropodus cupanus* (Cuv. & Val.) and on *Etroplus* by the same author (1938) appeared to be absent from the head of the larva of gourami.

Four-day old larva:—On the fourth day the larva (fig. 5) has the usual pigmentation in the eyes and the oral slit is replaced by a normal mouth. The pectoral fins also have assumed shape, but there is no ray formation in them.



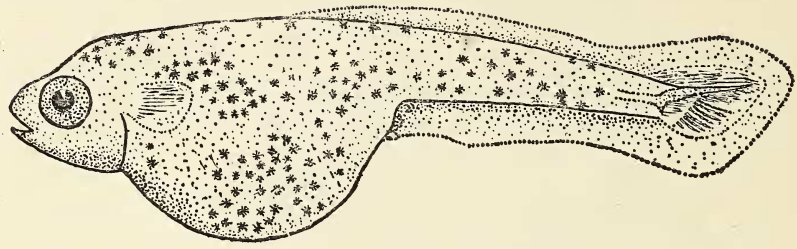
Text-fig. 5.—Four days old larva of *O. goramy* (Lacépède) ×Ca 16.

The larva is about 6.4 mm. in total length, with a yolk-sac of nearly the same size as on the first day. The head is contained about 8.5 times in the total length and the eye only about twice in the length of the head. The dorsal, caudal, anal or ventral fins are not developed. Only the vertical fin fold is present as before. The position of the vent is somewhat defined. A small pulsating heart, with coursing red blood corpuscles is visible below the throat. The chromatophores increase in number and occupy wider areas on the body.

On the fourth or fifth day the larva corrects its inverted position and swims in the normal manner of a fish. The movements are greatly restricted, however, and the larva prefers to shelter in the entangled fibres of the nest or on the bunches of *Ceratophyllum*, amongst which it remains motionless for a day or two. The duration of different stages depends on the conditions in the observation tanks. Some of these stages are earlier if conditions are favourable and later, if otherwise.

Seven-day old larva.—The larva acquires after about seven days a fish-like appearance, with its characteristic snout, eyes,

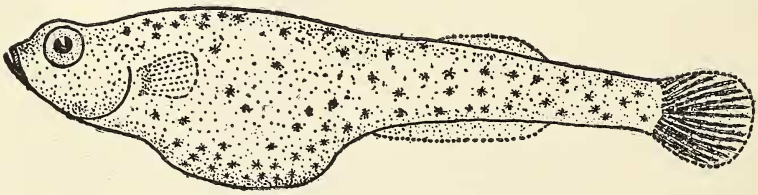
trunk and tail (fig. 6). It is about 7 mm. in length and has an elongated form.



Text-fig. 6.—Seven days old larva of *O. goramy* (Lacépède) ×Ca 14.

The yolk-sac is not absorbed, but appears to be partially incorporated 'in situ' in the body of the larva. This makes the anterior half of the body thick and the caudal portion slender. The head is contained about 7 times in the total length of the fish and the eyes are proportionately of the same size as in the former stage. They are prominent and are oblong as in many larval forms. The height of the head is slightly more than its length. The snout is bluntly pointed and is about $\frac{1}{2}$ the antero-posterior diameter of the eye. The height of the body is contained about 3.5 times in the total length. The membranous pectoral fins are clearly marked out. The vertical fin fold has proportionately the same length as was described in respect of the newly hatched larva and extends round the caudal end. The positions of the dorsal, caudal and the anal fins are, however, roughly marked out by the margin of the vertical fold sinking and approaching the body at spaces intervening between the fins concerned. The caudal fin appears to develop more rapidly and the rays appear in the process of formation. The ventral fins are as yet completely absent. The Chromatophores, which have increased both in number and size, are distributed all over the body, including the caudal region. They are more numerous on the ventral surface (yolk-sac) and on the head. The number of these chromatophores is not, however, sufficient to lend any general colour to the larva which, to all purposes, appears almost white to the naked eye.

Ten-day old larva.—The characteristics of the larva (fig. 7) when it is 9 or 10 days old generally tally with the description



Text-fig. 7.—Nine days old larva of *O. goramy* (Lacépède) ×Ca 11.

given by Roxas and Umali (op. cit.) of newly hatched fry (*vide* infra p. 238. In some respects, however, even their description would seem to require certain modifications.

The two authors (loc. cit.) record, 'The pectoral and the pelvic fins are entirely absent, although fleshy indications of the former are already visible'. My observations have shown (*vide* infra p. 241) that the fleshy indications of the pectorals are visible on the second day, when they are quite distinct and well developed. Another point of difference is that although the rounded abdomen of the larva appears to these authors as a portion of the original yolk-sac, yet it would not be proper in my opinion to consider the yolk-sac as still in existence, because it has by now been almost incorporated in the body of the larva.

A description of the later stages of Gourami is not included in these notes as the same has already been fully dealt with by Roxas and Umali.

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